Measuring the Thermal and Hygric Properties of Concrete in Dependence on the Applied Thermal and Mechanical Load

R. Černý, J. Maděra, and J. Poděbrādská
Department of Structural Mechanics
Faculty of Civil Engineering
Czech Technical University
Thakurova~7
166 29 Prague 6, Czech Republic

J. Drchalová and J. Toman
Department of Physics,
Faculty of Civil Engineering
Czech Technical University
Thakurova~7
166 29 Prague 6, Czech Republic

T. Klečka
Klokner Institute
Czech Technical University
Volinova~7
160 00 Prague 6, Czech Republic

K. Jurek
Institute of Physics
The Academy of Sciences of the Czech Republic
Na Slovance 2
180 40 Prague 8, Czech Republic

P. Rovnaníková
Institute of Chemistry
Faculty of Civil Engineering
Technical University of Brno
Zivzkova 17
662 37 Brno, Czech

Water vapor diffusion permeability, δ, liquid moisture diffusivity, κ, and thermal conductivity, λ, of concrete are determined on samples which were loaded either mechanically up to 90% of their compressive strength or thermally by an exposure up to 1000°C or by a combination of both types of load. In this paper the parameters under load are compared to the parameters measured on the samples without any load. This is an important step towards better understanding of behavior of concrete in real building structures, where, for instance, mechanically unloaded concrete structures are the exception.

The water vapor diffusion permeability is determined on the basis of the measured amount of water entering or leaving the sample during specified time intervals. The liquid moisture diffusivity is measured using a simple method developed recently in our laboratory and assuming piecewise constant κ. Thermal conductivity is determined using a hot wire technique. In the analysis of the reasons for the measured differences between δ, κ and λ of loaded and unloaded samples, scanning electron microscope, mercury porosimetry and DTA measurements are employed. The correlations between observed cracks and the changes in the hygric and thermal parameters are estimated, and practical recommendations concerning maximum thermal and mechanical load at which concrete is still safe from the point of view of its hygric and thermal parameters are formulated.